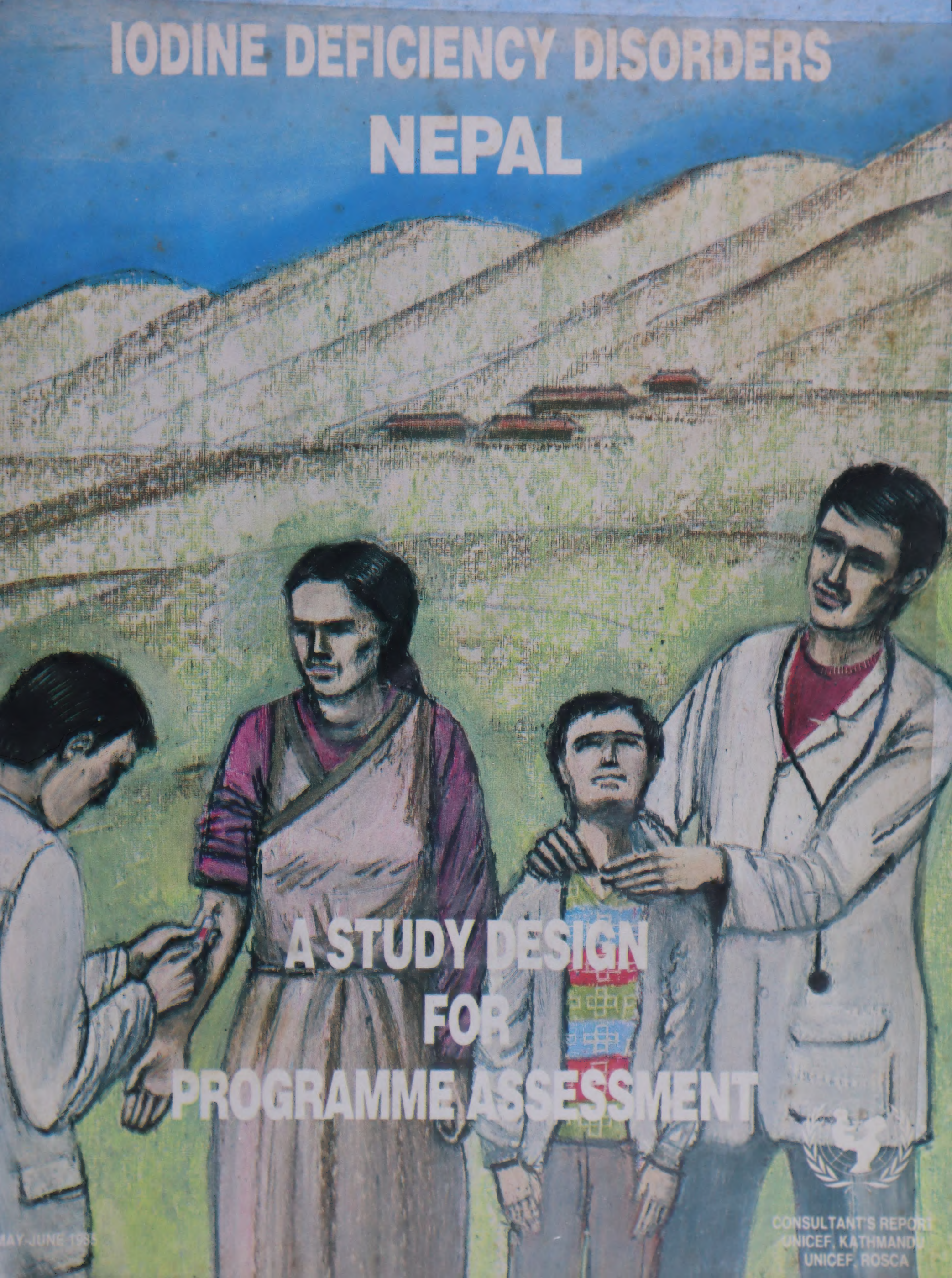
IODINE DEFICIENCY DISORDERS

NEPAL



A STUDY DESIGN FOR PROGRAMME ASSESSMENT

CONSULTANT'S REPORT
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IODINE DEFICIENCY DISORDERS IN NEPAL : A STUDY DESIGN

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IODINE DEFICIENCY DISORDERS

IN NEPAL

BY

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IODINE DEFICIENCY DISORDERS IN NEPAL

A STUDY DESIGN FOR PROGRAMME ASSESSMENT

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1. INTRODUCTION

Nepal, geographically belongs to the iodine deficient region of the Himalaya. It has been generally known for a long time that goitre is highly endemic in Nepal. A country-wide clinical survey and a large number of ad-hoc place specific surveys have been conducted in Nepal by a series of investigators. The first country-wide clinical survey for goitre was conducted by His Majesty's Government (HMG), Nepal, as a part of general health survey from 1965 to 1967.[1] A total of 19 villages were selected in a representative manner to include all the ecological zones of the country, covering one in every 1500 of the population. A total of 7466 persons were examined. Of these, 5265 were above 13 years and the goitre prevalence rate observed in them was 55%. The results of the survey confirmed the seriousness of endemic goitre in Nepal. Besides the hilly districts, the populous districts of Nepal Tarai were also found to be endemic for goitre. It was therefore concluded that endemic goitre is widely prevalent in Nepal.[1] Thereafter, Ramalingaswami et al in 1969[2], Delange et al in 1976[3], Bhattarai et al in 1979[4], Bergman et al in 1980[5] and Goitre and Cretinism Eradication Project [6,7], have carried a large number of ad-hoc surveys for endemic goitre and endemic cretinism and studied the iodine nutritional status in different areas of Nepal.

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Scientific study on the etiology and health consequences of endemic goitre, were for the first time undertaken in 1967 by Prof. Ramalingaswami and team, from the All India Institute of Medical Sciences, New Delhi[2]. They conducted clinical and a series of biochemical studies at Trisuli situated in Central part of Nepal and Jumla, situated in the North-Western part of the country and conclusively established that iodine deficiency is the cause of endemic goitre in Nepal.

In view of the evidence that endemic goitre in Nepal is a problem of serious public health significance and that iodine deficiency is its cause, it was recommended by Prof. Ramalingaswami and his team that a National Goitre Control Programme be launched to ensure a constant and continuous supply of iodine to the people. For this purpose, fortification of all edible salt with Potassium Iodate (KIO_3) at the level of 25 parts per million (PPM) was recommended[2].

In conformity with the recommendations made by Prof. Ramalingaswami and his team, salt iodation programme was launched by HMG Nepal in 1973, with the assistance from the Government of India[8,9]. Available information on goitre prevalence and urinary iodide excretion (UEI) pattern in Nepal, three to seven years after the initiation of salt iodation programme, clearly reveal

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amelioration of the severity of iodine deficiency[10]. However, there is reason to believe that adequate amount of iodine may not be reaching all parts of the country so as to effectively control Iodine Deficiency Disorders in Nepal.[3,10,11,12,13]

The Goitre and Cretinism Eradication Project (GCEP) was established by HMG Nepal in 1979, as a separate project attached to the Expanded Programme on Immunization (EPI), Department of Health Services, with the objectives of:

(i) reducing the incidence of endemic goitre and endemic cretinism in the Northern mountainous districts of the country where iodated salt is currently not available.

(ii) stimulating an awareness on the cause and consequences of goitre and cretinism in the general population and among government officials, and

(iii) assessing and evaluating alternative and inexpensive intervention methods for control of goitre and cretinism in Nepal[7].

During the HMG fiscal year 1979-80, the project was in the planning stages. Injection campaigns were carried out in Rasuwa and Jumla districts to test the methods of project implementation. The

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full scale project implementation of the programme began in fiscal year 1980-81. The target population consists of 90% of the total population of age group one month to 45 years, which roughly equals 76% of the total population. By 1984-85, the programme was to cover 28 districts with a target population of 28,33,850. So far, 19 districts with a target population of 14,52,263 have been covered with iodized oil injections. The coverage upto 1983-84 has been 87.8%. The remaining nine districts are being covered in 1984-85.[7,14,15]

It is important now to take stock of the existing status of Iodine Deficiency Disorders in the country before considering any new approach towards IDD control in Nepal. Therefore, there is a need to undertake a countrywide study of the population, on a random sample basis that would besides incorporating geographic, ethnic and populous districts of different administrative regions would also incorporate:

(i) those districts which have been covered by iodized oil injection campaign;

(ii) those districts where iodated salt coming from India is not likely to reach with adequate iodine content and not covered by iodized oil injections;

(iii) those districts where iodine is apparently reaching in satisfactory levels through iodated salt, i.e., Kathmandu valley and the other important populous townships in Nepal.

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Such a study would provide information on

(i) the impact of the on-going country-wide salt iodation programme.

(ii) the impact of recently completed Iodized Oil Injection Programme in 23 districts and

(iii) permit a situational analysis of IDD control in the country.[10]

Information gathered in such a study would be of vital importance to plan and implement future strategy of IDD control in Nepal so as to achieve IDD control by the year 2000 A.D., or even before in Nepal.[10]

2. OBJECTIVES

The following would be the proposed objectives of the study.

2.1) To determine the prevalence and severity of endemic goitre and endemic cretinism in a representative cross-section of the population incorporating geographic, ethnic and populous districts of different administrative regions covered by Iodised Oil Injections and Iodated Salt Programme.

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2.2) To assess the state of iodine nutriture as reflected in urinary excretion of iodide (UEI) in appropriate sample of the population.

2.3) To determine the hormonal status, i.e., thyroxine (T_4) and Thyroid Stimulating Hormone(TSH) in appropriate sample of the population, wherever feasible.

2.4) To determine the prevalence of endemic goitre and endemic cretinism in districts covered with Iodized Oil Injection Programme, selecting at least one district from the fiscal year 1979-80 to 1984-85 so as to determine the need for the repeat dose and the frequency and optimum dose of iodized oil injections.

2.5) To organise and assist in establishment of Iodine Monitoring Laboratories for estimation of

(a) iodine content in iodated salt

(b) iodine content in urine samples

(c) Creatinine content in urine samples.

2.6) To organize training for laboratory personnel in estimation of the above procedures.

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2.7) To organize training of health workers for conducting surveys to determine the prevalence and severity of endemic goitre and endemic cretinism.

2.8) To assist in the development of a comprehensive plan of action for the control of Iodine Deficiency Disorders.

3. METHODOLOGY AND WORK SCHEDULE

3.1 NEPAL & ITS PEOPLE

Nepal is a sovereign independent kingdom situated on the southern slopes of the mid-Himalayas. It has an area of 147,181 sq.km. with an estimated population of 15 million. Its rectangular shape stretches over a length of 885 Km (East-West) and a width of 145 to 241 Km (North-South). The major part of the country is of high mountains and rolling hills which accounts for 83 per cent of the total land area and remaining is occupied by flat lands of Tarai. Altitude varies between 152 metres above the sea-level in the south Tarai and over 8893 metres in the north Himalaya[16]. On the basis of altitude, the country can be divided into three natural regions.

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(i) Himalayan Region : This lies at an altitude of 4877 metres to 8839 metres above the sea-level with the snow-line running at 4877 metres. It accounts for 15 percent of the total land area and 8.6% of the total population.

(ii) Mountain Region : This region is formed by the Mahabharat range that soars upto 4877 metres. It is also known as Mid-Himalayas. To the south of it lies the Churia Range whose altitude varies between 610 to 1524 metres. The two ranges enclose between them, valleys of various width and altitude from 610 to 914 metres. They are known as the Doons or Inner Tarai. The mountain region accounts for 68 percent of the total land area and 47.7% of the total population reside in this region.

(iii) Tarai Region: The Tarai region has an altitude of maximum 305 metres. This region occupies about 17% percent of the total land area of the country and 43.7% of the total population stay in the Tarai region.[16]

Nepal is divided into five Developmental regions, 14 zones and 75 districts for administrative purposes. The Eastern Development Region has a total area of 24,856 Sq.kms. and comprises of three zones namely Mechi (four districts), Koshi (Six districts) and Sagarmatha (six districts) with

its headquarters at Dhankuta. The Central Developmental Region with a total area of 27,410 Sq.Kms and is composed of Janakpur (six districts) Narayani (five districts) and Bagmati (eight districts) zones with its headquarters at Kathmandu. The Western Development Region has a total area of 29,398 Sq.kms. and comprises of three zones namely Gandak (six districts), Lumbini (six districts) and Dhawalgiri (four districts) with its headquarters at Pokhara. The Mid-Western Developmental Region has a total area of 42,378 sq.kms. and consists of three zones namely Rapti (five districts), Karnali (five districts) and Bheri (five districts) with headquarters at Surkhet. The fifth, Far-Western Development Region has a total area of 19,539 sq.kms. and is composed of the remaining two zones, namely Seti (five districts) and Mahakali (four districts) and has its headquarters at Dipayal. The regions are responsible for the Development Work of their Zones and are guided by the National Planning Commission. The districts are further divided into Panchayats. Each Panchayat is again divided into wards. The number of wards in each Panchayat, all over the country, is nine.

3.2 SELECTIONS OF DISTRICTS AND PANCHAYATS

In selecting districts for the assessment of Iodine Deficiency Disorders, a judgemental sampling procedure was adopted. The selection was done in consultation with the Chief and Senior Health Officers, Goitre and Cretinism Eradication Project (EPI). HMG Government, Ministry of Health, Kathmandu and Programme Officer, Health, UNICEF Kathmandu. In selecting the districts the important considerations were to incorporate :

(i) districts which have been covered by iodized oil injection campaign.

(ii) at least one district from each of the fiscal year from 1979-80 to 1984-85, which have been covered by iodized oil injection campaign.

(iii) those districts from where iodated salt coming from India is not likely to reach with adequate iodine content and not covered by iodized oil injections.

(iv) those districts where iodine is apparently reaching in satisfactory levels through iodated salt i.e., Kathmandu Valley and the other important populous townships in Nepal.

(v) to include those districts in which base-line information on Iodine Deficiency Disorders is available.

(vi) at least one districts from each of the 14 administrative zones of the country.

(vii) at least one district from each of the geographic regions of the country i.e., from the Himalayan region, Mountain region and Tarai region from amongst the five developmental regions.

Based on these considerations, a total of 21 districts have been selected for the purpose of the study. The list of districts with the above mentioned particulars is given in Annexure-I and Annexure-II. After selecting a district, the Panchayats to be surveyed have been selected with the help of table of random numbers. In each district, five panchayats have been selected thus constituting the sampling frame for the study. Since one district has to be covered in nine working days, depending on the accessibility of the Panchayats, three Panchayats would be finally chosen for the survey. In the selected district, three percent of its total population will be covered. In each of the three Panchayats selected, the total number of persons examined would be in proportion to the Panchayats population and when added it would be equal to three percent of the total district population.

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3.3 POPULATION GROUPS TO BE STUDIED

(a) After selecting a Panchayat, a house to house survey would be conducted to collect information on Iodine Deficiency Disorders with the help of a pre-designed proforma. During the course of three working days at each Panchayat, the total number of persons examined would be in proportion to the Panchayat's population. Together it would be equal to three percent of the respective districts total population.

(b) If during the course of survey, district headquarter is visited, a representative sample of school children studying at the district headquarter will be surveyed.

3.4 STUDY TEAM

The study team would consists of six doctors from the All-India Institute of Medical Sciences, New Delhi (Annexure-III). Each team would comprise of two doctors. Thus, a total of three teams would simultaneously conduct surveys in the selected districts. Each team would cover the districts selected from Himalayan region, Mountain Region and Tarai region of the Developmental Region assigned to them. Of the three districts from Kathmandu Valley, one district each will be surveyed by each team. The members of the team have been working together

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since last seven years on Iodine Deficiency Disorders. The inter-observer variability will be controlled by discussions and practical demonstrations of the criteria to be used in the study. The senior and well experienced field staff from the Goitre and Cretinism Eradication Project and Doctors from AIIMS, New Delhi would form three functional teams. The participation of GCEP Staff is essential to establish a rapport with the community and their experience in IDD would be of great assistance and in addition they would also serve as interpreters.

3.5 TECHNIQUES OF STUDY

(a) CLINICAL PARAMETERS : The classification of goitre would be done as per the criteria adopted at the V meeting PAHO/WHO Technical Group on Endemic Goitre and Cretinism Control, Lima, Peru in November 1983 and at the Joint WHO/UNICEF Inter-country Workshop on Implementation of Control Programmes, for Iodine Deficiency Disorders, New Delhi in March 1985 (Annexure-IV)[17,18]. All individuals examined would clinically be screened for endemic cretinism, as defined by the Pan American Health Organisation (Annexure - V)[19]. A record of all the individuals examined would be maintained with the help of a predesigned proforma (Annexure-IV).

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(b) LABORATORY PARAMETRES :

(i) During the course of survey, single casual urine samples would be collected on the spot for quantifying urinary iodine and creatinine. The samples would be collected in iodine-free, wide mouthed screw-capped plastic bottles with toluene (sulphur free AR Grade BDH) added as preservative. On an average 30 ml of urine would be collected from each individual.

The sampling procedure adopted for collection of urine sample would be one in twenty (1-20) of the population examined with a minimum of 30 samples to be collected from a Panchayat under survey.

These would be collected with the help of random table numbers (Annexure XIV and Annexure XV)[27,28]. The procedure of collection would be explained to the study population by the members of the team.

After covering the assigned districts, the samples would be brought to Kathmandu from where they would be despatched to the All India Institute of Medical Sciences laboratory for speedy analysis of creatinine.

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Urinary stable iodide estimation would be done by a modified alkali ash method of Barker et al (Annexure VII)[21]. Urinary creatinine would be quantified by the alkaline picrate method described by King and Wooten (Annexure - VIII)[22]. The results of urine analysis would be expressed as microgrammes of iodine per gram of creatinine. This expression would faithfully reflect the iodine nutritional status of the population under study.

(ii) An attempt would be made to collect blood samples on No.3 Whatman filter paper, from all those individuals whose urine samples would be collected. The filter paper strip after drying it in shade would be preserved in a specially designed envelope, with inner lining of black paper. Thyroxine (T_4) and Thyroid Stimulating Hormone (TSH) would be determined by radio-immuno assays (RIA) by the adapted spot assay technique as described from the AIIMS laboratory [24].

(iii) During the course of the study an attempt would be made to initiate screening for neonatal hypothyroidism at birth, at different places. The procedure for collection of cord-blood specimens would be explained to the health personnel concerned with the conduct of delivery (Annexure -IX)[25].

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(c) KNOWLEDGE, ATTITUDE, PRACTICE (KAP) SURVEY: During the course of the survey, in a representative sample of the population, Knowledge, Attitude, Practice (KAP) survey would be done on Iodine Deficiency Disorders and Iodized Oil with the help of a predesigned proforma (Annexure X and Annexure XI).

(d) COLLECTION OF IODATED SALT SAMPLES : During the course of the study, iodated salt samples would be collected from salt iodation plant, salt godowns, wholesaler traders, retail outlets and from house hold. Information on iodated salt will be gathered with the help of a pre-designed proforma (Annexure - XII).

Assistance of Central Food Research Laboratory, Kathmandu would be requested for carrying out analysis of iodine content in the salt samples collected. Iodine content would be estimated by the method as described in the "The use of iodated salt in the prevention of Iodine Deficiency Disorders - A handbook of monitoring and quality control" (Annexure - XIII)[26]. This method has been demonstrated and standardized at the Central Food Research Laboratory, Kathmandu [13].

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LIST OF ANNEXURES

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ANNEXURE - I

CURRENT STATUS OF IODINE DEFICIENCY DISORDERS IN DISTRICTS TO BE SURVEYED IN NEPAL

Sr. No.	Region	Zone	District	Geographical Location	Population	Year of Iodised Oil Admin.	Salt Plant Godown	Baseline data on IDD			
								n	Goitre Prevention	Cretinism Prevelence	Urinary Excretion of Iodide*
I.	EASTERN	MECHI	PANCHTHAR	M	153,746	1984-85	NO	9973	68.7%	NIL	NE
		KOSHI	SANKHUASABHA	H/M	129,414	1981-82	NO	5562	60%	0.68%	NE
		SAGARMATHA	SIRAHA	T	375,358	Not yet	NO	NE	NE	NE	NE
II.	CENTRAL	BAGMATI	RASUWA	H	30,241	1979	NO	2575	62%	4.8%	34
		BAGMATI	NUWAKOT	M	202,976	1983-84	NO	258	55%	-	61
		JANAKPUR	DOLKHA	H/M	150,576	1983-84	NO	1770	47.1%	1.2%	NE
		NARAYANI	PARSA	T	284,348	Not Yet	Plant at Birganj	NE	NE	NE	NE
III.	WESTERN	GANDAKI	GORAKHA	M	231,254	1982-83	NO	3466	70%	NE	NE
		DHAULAGIRI	MUSTANG	H	12,930	1982-83	NO	355	66.2%	2.5%	NE
		DHAULAGIRI	MYGADI	M	96,904	Not Yet	NO	NE	NE	NE	NE
		LUMBINI	RUPANDEHI	T	379,096	Not Yet	Plant at Bhairwa	NE	NE	NE	NE
IV.	MID-WESTERN	RAPTI	DANG DEOKHARI	M	266,393	1984-85	NO	2815	59.2%	NE	NE
		BHERI	BANKE	T	205,323	Not Yet	Plant at Nepalganj	NE	NE	NE	NE
		KARNALI	DOIPA	H	22,043	1980-81	NO	NE	NE	NE	NE
		KARNALI	JUNLA	H/M	68,797	1979	NO	890	83.9%	10.6%	24
V.	FAR-WESTERN	SETI	BAJHANG	H/M	124,018	1981-82	NO	NE	NE	NE	NE
		SETI	KAILALI	T	257,905	Not Yet	Plant at Dhomgadi	NE	NE	NE	NE
		MAHAKALI	DANDELDHURA	M	86,853	Not Yet	NO	NE	NE	NE	NE
VI	KATHMANDU VALLEY	BAGMATI	KATHMANDU	M	422,237	Not Yet	GODOWN	880	56%	NE	65
		BAGMATI	LALITPUR	M	184,341	Not Yet	NO	NE	NE	NE	NE
		BAGMATI	BHAKTAPUR	M	156,767	Not Yet	NO	NE	NE	NE	NE

GEOGRAPHICAL LOCATION : H = HIMALAYAN, M = MOUNTAINOUS, T = TARAI

BASELINE DATA ON IDD : n = Total No. examined
NE = Not Estimated
* = ug of iodine per gm creatinine.

ANNEXURE - II

LIST OF PANCHAYATS TO BE SURVEYED

I.EASTERN DEVELOPMENTAL REGION

			Tot. Population
(1)	MECHI ZONE :	(i) PANCHTAR DISTRICT	
	(a)	Prangbung	3,806
	(b)	Chokarangu	4,055
	(c)	Lungrupa	4,663
	(d)	Sudanga	1,995
	(e)	Sujhang	4,443
(2)	KOSHI ZONE :	(ii) SANKHUASABHA DISTRICT	
	(a)	Pawakhola	2,264
	(b)	Myastra Pokhari	3,660
	(c)	Wana 5,109	
	(d)	Pathivara	2,535
	(e)	Hatiyan	2,574
(3)	SAGARMATHA ZONE :	(iii) SIRAHA DISTRICT	
	(a)	Dhengatri	5,151
	(b)	Kalyanpur	6,421
	(c)	Bhagalapur	8,643
	(d)	Barchhawa	5,440
	(e)	Siraha	8,074

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II. CENTRAL DEVELOPMENTAL REGION :

(4)	BAGMATI ZONE	(iv) RASUWA DISTRICT	
	(a)	Lamtang Panchayat	390
	(b)	Dhaibung	2,892
	(c)	Bharle	4,022
	(d)	Saramthodi	2,684
	(e)	Yarsa	2,997
		(v) NAWAKOT DISTRICT	
	(a)	Dang Panchayat	4,867
	(b)	Trisuli	5,605
	(c)	Kintang	2,922
	(d)	Samari	4,167
	(e)	Dul Papal	4,826
(5)	JANAKPUR ZONE	(vi) DOLKHA DISTRICT	
	(a)	Chilamkha Panchayat	2,310
	(b)	Chhetrapa Panchayat	2,167
	(c)	Japhe Panchayat	2,723
	(d)	Pawati Panchayat	6,569
	(e)	Dolkha Panchayat	3,463
(6)	NARAYANI ZONE	(vii) PARSA DISTRICT	
	(a)	Aurahaninchura	6,017
	(b)	Tihumi	9,443
	(c)	Nirmal Basti	7,855
	(d)	Maluban	6,408
	(e)	Surlahn Passumi	4,703

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III WESTERN DEVELOPMENT REGION

(7)	GANDAKI ZONE	(viii) GORAKHA DISTRICT	
	(a)	Gyalchok Panchayat	3,928
	(b)	Manakawami	4,354
	(c)	Taku	6,951
	(d)	Harmi	5,690
	(e)	Ghairung	4,059
(8)	DHAULAGIRI ZONE	(ix) MUSTANG DISTRICT	
	(a)	Kobang Panchayat	695
	(b)	Chhondrap	915
	(c)	Tubucha	475
	(d)	Harmi	768
	(e)	Lomanthan	630
		(x) MYAGADI DISTRICT	
	(a)	Okharbot Panchayat	2,420
	(b)	Baraha Panchat	2,259
	(c)	Kuhu	6,435
	(d)	Takam	2,916
	(e)	Baranja	4,666
(9)	LUMBINI ZONE	(xi) RUPANDEHI DISTRICT	
	(a)	Basantapur Panchayat	6,116
	(b)	Balarampur Panchayat	10,262
	(c)	Suryapuri Panchayat	10,367
	(d)	Lumbini Panchayat	8,301
	(e)	Semara Panchayat	6,392

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IV. MID-WESTERN DEVELEPMENTAL REGION

(10)	RAPTI ZONE	(xii) DANGDEOKHURI DISTRICT	
	(a)	Rampur Panchayat	7,097
	(b)	Koilabas Panchayat	2,599
	(c)	Satbariya Panchayat	6,360
	(d)	Hekuli Panchayat	7,808
	(e)	Baghmari Panchayat	9,402
(11)	BHERI ZONE	(xii) BANKE DISTRICT	
	(a)	Dhampur Panchayat	8,408
	(b)	Kachanpur	6,073
	(c)	Laximanpur	5,317
	(d)	Mahanpur	4,905
	(e)	Gijara	5,359
(12)	KARNALI ZONE	(xiv) DOLPA DISTRICT	
	(a)	Sahatara Panchayat	1,467
	(b)	Baharakot Panchayat	556
	(c)	Tripurakot Panchayat	1,571
	(d)	Dharka Panchayat	532
	(e)	Foksundo Panchayat	428
	(xv)	JUMLA DISTRICT	
	(a)	Chimdi Panchayat	3,391
	(b)	Jumlakot Panchayat	3,177
	(c)	Talium Panchayat	3,614
	(d)	Patrasi Panchayat	2,793
	(e)	Depal Gaum Panchayat	1,371

/...

V. FAR-EASTERN DEVELOPMENTAL REGION

(13) SETI ZONE	(xvi) BAJHANG DISTRICT		
	(a)	Khairatadi Panchayat	3,968
	(b)	Subeda Panchayat	3,418
	(c)	Bhatikhola Panchayat	4,425
	(d)	Kalukheli Panchayat	1,995
	(e)	Dahawagar Panchayat	3,232
	(xvii) KAILALI DISTRICT		
	(a)	Dharampura Panchayat	15,514
	(b)	Nigali Panchayat	6,630
	(c)	Sathipani Panchayat	4,961
	(d)	Dhangadi Nagar	26,068
	(e)	Nuhari Panchayat	7,411
(14) MAHAKALI ZONE	(xviii) DADELDHURA DISTRICT		
	(a)	Ghatal Panchayat	3,675
	(b)	Ughatara	2,277
	(c)	Rai Panchayat	2,978
	(d)	Alital Panchayat	5,548
	(e)	Mastamandu	2,725
VI. KATHMANDU VALLEY	(xix) KATHMANDU DISTRICT		
	(a)	Kathmandu Nagar	2,35,211
	(b)	Chobhar Panchayat	4,576
	(c)	Bagh Bhauran	6,535
	(d)	Manamaiju	5,217
	(e)	Thankot	6,195

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(xx)	<u>LALITPUR DISTRICT</u>	
(a)	Imadol Panchayat	5,038
(b)	Choghadi Panchayat	1,464
(c)	Goitikhel	1,480
(d)	Nallu	1,676
(e)	Chandanpur	2,389
(xxi)	<u>BHAKTPUR DISTRICT</u>	
(a)	Nakhel Panchayat	3,969
(b)	Dhadikot	4,672
(c)	Bade	5,628
(d)	Balkot	3,611
(e)	Lamtar	6,746

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ANNEXURE III

MEMBERS OF THE STUDY TEAM

A. UNICEF CONSULTANTS from All India Institute of Medical Sciences, New Delhi

1. Dr M G Karmarkar, Associate Professor,
   Department of Endocrinology & Metabolism.
   -Team Leader

2. Dr N Kochupillai, Associate Professor,
   Department of Endocrinology & Metabolism.

3. Dr L M Nath, Professor & Head,
   Centre for Community Medicine.

4. Dr C S Pandav, Lecturer,
   Centre for Community Medicine.

5. Dr M M Godbole, Senior Research Officer,
   Department of Endocrinology & Metabolism.

6. Dr G P Sharma, Senior Research Officer,
   Department of Endocrinology & Metabolism.

B. NATIONAL CONSULTANTS

1. Dr Suniti K Acharya, Chief, Goitre & Cretinism
   Eradication Project.

2. Mr Shyam Raj Kunwar

3. Mr Tirth Bahadur K C

4. Mr Narayan Shrestha

5. Mr Ram Bahadur

6. Mr Bhim Bahadur K C

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ANNEXURE IV

DEFINITIONS OF ENDEMIC GOITRE AND ENDEMIC CRETINISM CLASSIFICATION OF GOITRE SIZE AND SEVERITY OF ENDEMIAS AND SURVEY TECHNIQUES (PAHO/WHO 1983)

1. Definition of Goitre Stages

A. Definition of Goitre

A normal thyroid gland should have the minimal size compatible with euthyroidism under conditions of normal iodine intake (100-150 ug/day). This gland would be non-palpable.

For practical purposes, the definition of goitre of Perez et al is recommended: "A thyroid gland whose lateral lobes have a volume greater than the terminal phalanges of the thumbs of the person examined will be considered goitrous".

B. Estimation of thyroid size

We recommended a slight modification of the system of Perez et al.

Stage 0:	No goitre.
Stage Ia:	Goitre detectable only by palpation and not visible even when the neck is fully extended.

/...

Stage Ib: Goitre palpable and visible only when the neck is fully extended. This stage also included nodular glands, even if not goitrous - see Section C below.

Stage II: Goitre visible with the neck in normal position; palpation is not needed for diagnosis.

Stage III: Very large goitre which can be recognized at a considerable distance.

In case of doubt between any two of these stages, the lower should be recorded.

Measurement of thyroid surfaces by the procedure of MacLennon and Gaitan is particularly recommended for standardization of technique among different examiners and for comparison of surveys in different areas and at different times.

The total goitre rate is the prevalence of Stages I + II + III; the visible goitre rate is the prevalence of Stage II + III.

This classification is appropriate to field surveys for public health purposes. For clinical purposes, more precise information can be obtained by other techniques including scintigraphy and sonography.

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ANNEXURE V

DEFINITION OF ENDEMIC CRETINISM (PAHO, 1974)

"The condition of endemic cretinism is defined by three major features".

A. Epidemiology: It is associated with endemic goitre and severe iodine deficiency.

B. Clinical manifestations: These comprise mental deficiency together with either:

(1) A predominant neurological syndrome consisting of defects of hearing and speech, and with characteristic disorders of stance and gait of varying degree; or

(2) Predominant hypothyroidism and stunted growth. Although in some regions one of the types may predominate, in other areas a mixture of the two syndromes will occur.

C. Prevention: In areas where adequate correction of iodine deficiency has been achieved, endemic cretinism has been prevented.

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ANNEXURE - VI

IODINE DEFICIENCY DISORDERS (IDD) ASSESSMENT PROFORMA HOUSEHOLD/COMMUNITY

District Panchayat Ward Village Date of Survey

Ethnic Group Himalayan (H): Sherpa Tamangs Kirantis Limbus Bhutias Mountains (M) Magars, Tamangs, Sunwars, Newars, Brahmins, Cheetriyas TARAI (T) = Magars, Tharus, Danwars, Chepang, Immigrants

Sr. No.	Name	Age (Yrs)	Sex M	Sex F	Sex O	Goitre Grade 1a	Goitre Grade 1b	Goitre Grade 2	Goitre Grade 3	Nodular Yes	Nodular No	Compression Symptoms Breathing	Compression Symptoms Swallowing	ENDEMIC CRETINISM Feeble Mindedness	Gait & Stance	Speech Defects	Hearing Defects	Stunted Growth	Hypo thyroidism	Urine Sample No.	Height (cms.)	Blood Sample No.	ug of Iodine/day	T_4 ug/dl.	TSH ug/ml	REMARKS
1.														1.												
2.														2.												
3.														3.												
4.														4.												
5.														5.												

Annexure VII

PRINCIPLE AND PROCEDURE OF IODINE ESTIMATION IN BIOLOGICAL FLUIDS (URINE AND SERUM) AND WATER

PRINCIPLE OF IODIDE ESTIMATION:

Serum, Urinary or water iodide is estimated by dry ashing in presence of Sodium Carbonate and then iodide present in the ash is measured by cerric-arsenite system.

The reaction is:

$$Ce\ (ic) + AS(ous) \xrightarrow{I^-} Ce\ (ous) + AS\ (ic)$$

Cerric ammonium sulphate (Cerric ions) gets converted into cerrous ammonium sulphate (Cerrous ions) in presence of Arsenous Acid which gets converted into Arsenic Acid. Inorganic iodide acts as a catalyst for this reaction. Thus the change of cerric ions into cerrous ions depends on the amount of inorganic iodide present. Ce(ic) ions are yellow in colour while Ce(ous ions are colourless. This reaction therefore, can be estimated colorimetrically.

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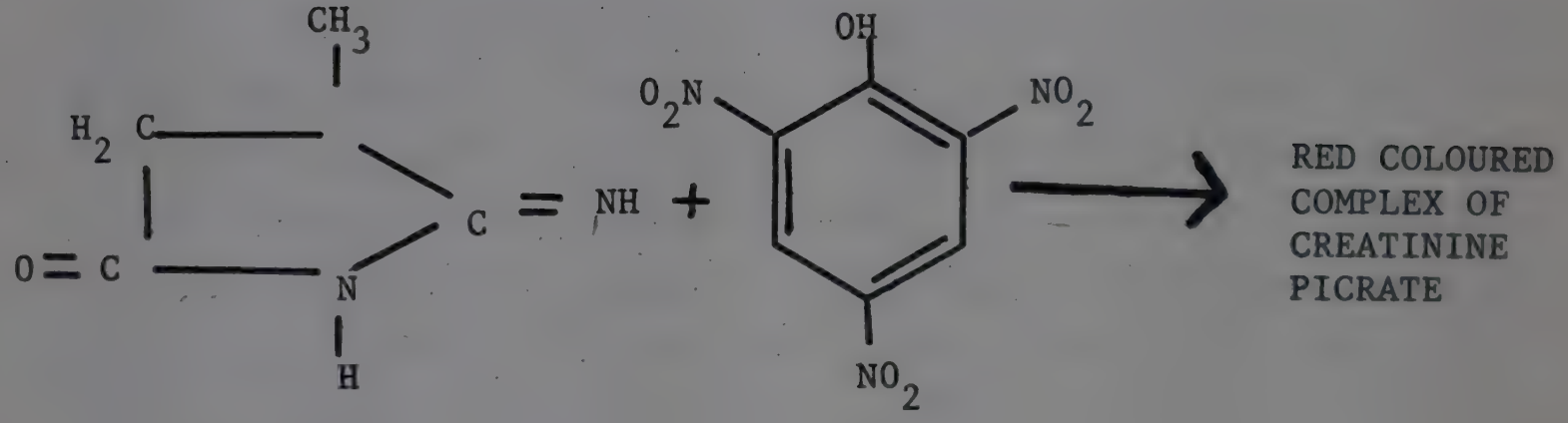
Annexure VIII

Creatinine Estimation

Creatinine reacts with picric acid in alkaline condition to give coloured complex which is measured colorimetrically.



CREATININE

PICRIC ACID

(ALKALINE CONDITION)

PROCEDURE FOR ESTIMATION OF IODINE IN URINE AND SERUM

Chemicals and Reagents

1. POTASSIUM CARBONATE - K_2CO_3, 2.5N. A.R. grade (BDH).

   Dissolve 17.5 gm of anhydrous potassium carbonate in small amount of double distilled water and dilute it to 100 ml and store it in a polythelene bottle.

2. CERRIC AMMONIUM SULPHATE - 0.005N, A.R. grade

   Dissolve 3.17 gm of cerric ammonium sulphate in 500 ml of double distilled water and 57 ml conc. H_2SO_4 and diluted to one litre.

3. SODIUM META-ARSENITE - 0.035N, A.R. grade.

   Dissolve 2.27 gm of AR grade sodium meta arsenite ($NaAsO_2$) in 500 ml double distilled water. Add to this 46 ml conc. H_2SO_4 and and make up by adding double distilled water to one litre.

4. STOCK IODINE - 100 mg/100 ml.

   Standard.

/...

PROCEDURE:

For estimation of iodine in serum, add a pinch of Amberlite resin in the serum sample and then pipette out 100 ul of serum sample in each tube. The steps 2 to 4 are the same as for iodine estimation in urine.

1. Pipette out 100 ul urine sample in each tube.

2. Add standard and blank to the respective tubes (as per protocol prepared).

3. Add 300 ul of K_2CO_3 to each tube of vortex.

4. Keep the rack at 80 C overnight for evaporation.

5. Keep the same rack for ashing in the furnace at 600 C for two hours.

6. Switch off the furnace, let the temperature be lower down, then take out the rack from the furnace.

7. Add 3 ml of sodium meta arsenite and centrifuge the tubes at 2500 rpm for seven minutes and collect the supernatant in respective tubes.

8. Incubate the supernatant containing tubes for five minutes at 56^0C.

9. Add 3 ml of cerric ammonium sulphate at 30 sec. interval to each tube, mix and replace the tubes.

10. EXACT AFTER 20 MINUTES measure the transmittence at 420 M/u against water blank (BLUE FILTER).

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PROCEDURE FOR ESTIMATION OF IODINE CONTENT IN WATER

CHEMICALS AND PREPARATION OF REAGENTS

1. Standard NaCl - 20% NaCl.
   Standard NaCl is purified by dissolving in boiling double distilled water, filtering and allowing to recrystallise. Then the crystals are separated and dried in an oven.

2. Conc. H_0SO_4 60% (V/v).
   60 ml conc. H_2SO_4 pour slowly into 40 ml of double distilled water.

3. 0.IN; As_2O_3 - Arsenious acid.
   Dissolve by heating 4.946 gm of arsenic trioxide in about 500 ml double distilled water acdified with 10 drops of H_2SO_4. Make up to one litre by adding double distilled water.

4. 0.02N Ce $(SO_4)2$, $2(NH_4)2$ SO - 4 H_2O.
   Ceric ammonium sulphate.
   13.38 gm of ceric ammonium sulphate in 600 ml double distilled water. Add 44 ml of conc. H_2SO_4 and make up to one litre by adding double distilled water.

5. $(NH_4)2SO_4$; $FeSO_4$; $6H_2O$, Ferrous ammonium sulphate.
   1.5% in 0.6% H_2SO_4.

6. KCN - Potassium thiocyanate - 4%.

/...

PROCEDURE:

1. Take 7.0 ml of water sample.

2. Add 1.0 ml of 20% NaCl.

3. 0.5 ml of 60% H_2SO_4.

4. 0.5 ml of Arsenious acid.
   Vortex all the tubes and keep in a waterbath at 30^0C.

5. Add 1 ml ceric ammonium sulphate to all the tubes.

6. EXACTLY AFTER 20 MINUTES - Add 1 ml of ferrous ammonium sulphate to stop the reaction.

7. Add 0.5 ml of potassium thiocynate to get a BRICK RED COLOUR.

8. Read with 550 M/u. GREEN FILTER.

/...

Annexure IX

METHODOLOGY FOR ORGANISING NEONATAL HYPOTHYROID SCREENING PROGRAMME - AN INDIAN EXPERIENCE

Districts with highest prevalence of goitre are selected for the purpose of introducing Neonatal Hypothyroid screening programme. A meeting is called at the headquarters of a Primary Health Centre (P.H.C.) which is attended by Chief Medical Officer, Medical Officers of P.H.C. and all other staff of P.H.C. With the help of appropriate teaching aids, Auxillary Nurse Midwife (A.N.M.) and Traditional Birth Attendants (T.B.A.) are instructed on goitre problem in their area, health consequences of iodine deficiency i.e. mental retardation, stunted growth, deaf-mutism and hypothyroidism. Importance of early diagnosis and prompt treatment of neonatal hypothyroidism with thyroxine tablets for at least one year, is emphasized. All the ANMs and TBAs are then given a filter paper strip (No.3 Whatman's filter paper). A demonstration of collection of cord blood on the filter paper strips is made with emphasis on size and uniformity of the blood spot, and drying it in shade. They are instructed as to how to label and despatch the filter paper strip on which cord blood is collected, by putting them in a specially designed (with black-paper lining) pre-paid envelopes provided to them. After ensuring that they understood the message and method, filter paper strips with appropriate number of envelopes are distributed subcentrewise after giving each subcentre a code number. This facilitates in tracing back the address of the detected hypothyroid child and treatment with thyroxine tablets is initiated without any delay. A printed list of instructions with details for collection of cord blood on filter paper strips is given to the ANM and TBAs for ready reference.

/...

After the strips reach Endocrine and Metabolism Laboratory (A.I.I.M.S., New Delhi), with the help of McGill punches, discs of 1/4" (TSH) and 1/8" (T_4 and r-T_3) diameter are punched in duplicate from the filter paper blood spot.

After extracting serum from these discs, hormonal estimations are done by using Radioimmunoassay systems. Initially, all the discs of 1/8" diameter are assayed for Thyroxin (T_4) and reverse Tri-iodothyronine (r-T_3) levels. When the T_4 value is below 2 S.D. and r-T_3 below 1 S.D. of the respective means from the non-endemic areas, then the Thyroid Stimulating Hormone (TSH) is estimated in discs of 1/4" diameter, cut from the same filter paper strip. If TSH value is above 50 uu/ml, then the child is diagnosed as hypothyroid.

The details on the strips and code numbers on envelopes facilitates in tracing the address of the hypothyroid child. A telegram is sent to the Medical Officer-In-Charge of Primary Health Centre, who initiates treatment with thyroxine on the detected hypothyroid children. A stock of thyroxine tablets is kept with Medical Officer-In-Charge of PHC. These tablets are given free of cost for a period of one year. A follow up of these hypothyroid children is assessed in the fortnightly meetings of PHC staff held at the headquarters of PHC.

NOTE: Quantitation of cord blood hormone levels in direct specimens will be done within the frame-work of submitted budget. However, if an ongoing Neonatal Hypothyroid Screening Programme of the type suggested is to be undertaken, appropriate resources are to be provided by WHO, in a phased manner, over the course of the desired screening programme.

/...

Annexure X

K.A.P. PROFORMA ON I.D.D.

1. What is the local name for goitre?

2. What is the cause of goitre?

3. Any local treatment for goitre?

4. Does it help? Yes No Don't Know

5. Does this goitre cause any problems? Yes No Don't Know

6. What problems?

7. What is the local name for cretinism?

8. What is the cause of cretinism?

9. Any local treatment for cretinism?

10. Does it help? Yes No Don't Know

11. Any association between Goitre & Cretinism? Yes No Don't Know

/...

12. What is the local name for salt?

13. Where do you buy your salt from?

14. At what price?

15. How much do you buy at a time?

16. How often do you buy it?

17. Where do you store it in house?

18. Do you wash it before using it?

19. Does it contain any medicine? Yes No Don't Know

20. If yes, what?

/...

Annexure XI

IODISED OIL ASSESSMENT PROFORMA

1. IDENTIFICATION

Date of Survey:

District: Panchayat:

Ward: Village:

Name:

Age:_____years. Sex: Male: Female:

Ethnic Groups:

Health Altitudes (H): Sherpas Tamangs Kirantis Limbu Bhutias

Mid-Mountains (M): Magars Tamangs Sunwars Newars Brahmins Chhetriyas

Tarai (T): Magars Tharus Danuwars Chepang Immigrants

/...

(Show Iodised Oil and Disposable Syringe and Needle)

1. Iodised Oil Injection Received? Yes No

2. How many years back? 6 5 4 3 2 1 less than 1 Don't remember

3. Where did you receive injection? Upper arm Thigh

4. Any problem after injection? Pain Swelling Swelling with fever (Abscess);
Don't remember No. Any other.

5. Who gave the injection?

6. Did you receive any card after receiving injection? Yes No

7. What was the colour? Don't remember Not sure White

8. Do you have the card with you? Yes No

9. (Show the white card) Have you seen this card before?
Yes No Don't remember

10. Has the injection benefitted? Yes No

11. In what way?

12. Would you like to receive it again? Yes No

/...

ANNEXURE - XII

IODATED SALT ANALYSIS PROFORMA

1. Name of Salt Dealer :

2. Address :
   Ward _____ Panchayat _____ Dist._____

3. Wholesaler : Yes No Retailer: Yes No

4. Date of Purchase of iodated salt :

5. Quantity purchased per week _____, per month _____

6. Cost of 100 Kg Bag Rs._____, 75 Kg. Bag Rs. _____

7. Storage facility : Indoor Outdoor
   Covered Uncovered
   Jute Bags Wooden Box
   Floor : Cement Muddy

8. Average duration of storage of salt
   Less than 1 Week 1 Week 2 Weeks 3 Weeks 4 Weeks

9. Selling price of iodated salt to Retailers Rs. _____
   Consumers Rs._____

10. Iodated salt sample No. _____

/...

11. Date of Iodated salt sample collection

12. Duration of storage of sample at the time of collection

13. Name of the collector

14. Date of iodated salt analysis

15. Place of iodated salt analysis

16. Name of the Analyst

17. Results : Iodine Content _____ parts per million (PPM)

18. Report sent to (i) Salt Trading Corporation, Date
(ii) Iodated Salt Plant, Date
(iii) Goitre & Cretinism Eradication Project

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ANNEXURE - XIII

PRINCIPLE AND PROCEDURE OF IODINE ESTIMATION IN SALT IODINATED WITH POTASSIUM IODATE

PRINCIPLE :

Iodate present in the iodated salt is converted into iodine by addition of sulphuric acid. Iodine liberated is trapped by addition of Potassium Iodate solution. The iodine is then titrated against sodium thiosulphate using starch as an external indic for and the results calculated using the table provided.

PROCEDURE FOR ESTIMATION OF IODINE CONTENT OF A SALT IODIZED WITH POTTASIUM IODATE

Dissolve 50 gms of given salt sample in 250 ml of double distilled water. Take 50 ml of this solution and add 1 ml of 2N, H_2SO_4 and 5 ml of 10% potassium iodate solution. Shake well.

Stopper the flask and keep it in DARK for 10 minutes. Titrate the liberated iodine with 0.005N, $Na_2S_2O_3$, using 1% starch as an external indicator.

1. 1 ml of 0.005N, $Na_2S_2O_3$ - 0.1058 mg of Iodine.

2. Multiply the titration reading with 0.1058 mg which will give mg of Iodine per 10 gm of salt

/...

3. Multiply the mg of Iodine value per 10 gm of salt by 100 to get the value of Iodine as per parts per million (PPM)

CHEMICALS AND PREPARATION OF REAGENTS FOR IODINE CONTENTS IN IODIZED SALT

1. SODIUM THIOSULPHATE - $Na_2S_2O_3$, A.R. grade 0.005N, $Na_2S_2O_3$ 1.2409 gm AR grade $Na_2S_2O_3$ dissolved in 1 litre of boiled double distilled water.

2. 2N; H_2SO_4, Two normal, sulphuric acid. 5.56 ml of concentrated acid added in a double distilled water such that total volume would be 100 ml.
(CAUTION - In diluting sulphuric acid always add the acid to water)

3. Potassium Iodine - KI, AR grade
10%; KI
10 gm of AR grade KI dissolved in 10 ml of double distilled water

4. SOLUBLE STARCH -

1% Soluble starch solution
1 gm of soluble starch dissolved in 10 ml of boiling double distilled water adding to 90 ml saturated NaCl solution.

/...

ANNEXURE - XIV

CALCULATION OF SAMPLE SIZE IN IDD SURVEYS

1. Divide upon the estimated prevalence of the disease from previous surveys/reports :
   Suppose, the prevalence of goitre in a given community is 10%.

2. Decide upon the level of relative standard error :
   Let us assume the relative standard error to be 25%.
   That means, the maximum variation limits of the supposed prevalence of goitre i.e. 10% is 25% of 10 i.e. 2.5
   The expected value will vary between 10$\pm$ 2.5 i.e. 7.5% and 12.5%

3. At 95% level of confidence interval (P/ 0.05), - the standard error of proportion is =

$$= \frac{\text{Maximum variation}}{2}$$

$$= \frac{2.5}{2} = 1.25$$

4. Applying the formula to determine the sample size (n)
   p = with disease
   q = without disease

$$\text{S.E. of Proportion} = \frac{p \times q}{n}$$

$$n = \frac{p \times q}{(SE)^2} = \frac{10 \times 90}{(1.25)^2}$$

$$= 576$$

5. Thus, when the goitre prevalence is 10%, only 576 people need to be examined to obtain a 95% confidence interval covering a range given by 10% $\pm$ 25% of this value i.e. (10 x 0.75)% to (10 x 1.25)% = 7.5% to 2.5%

/...

Relationship between prevalence of goitre, number of persons to be examined, and relative error of findings (based on a 95% confidence interval)

Prevalence of goitre (%)	No of persons to be examined to achieve the following relative error				
	10%	20%	25%	30%	40%
5	7,600	1,900	1,216	855	485
10	3,600	900	576	405	225
20	1,600	400	256	180	100
30	932	233	150	105	58
40	600	150	96	68	38
50	400	100	64	45	25

Example : When the goitre prevalence is 30% only 150 people need be examined to obtain a 95% confidence interval covering a range given by 30% plus or minus 25% of this value i.e., (30 X 0.75)% to (30 X 1.25% = 22.5% to 37.5%

/...

ANNEXURE - XV

RANDOM SAMPLING NUMBERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	6	3	0	5	6	4	2	2	4	8	6	5	8	5	8
2	3	6	3	2	6	1	8	3	2	8	5	8	5	1	3	7
3	7	2	0	5	8	6	2	8	2	6	0	8	1	3	6	5
4	9	9	6	5	5	5	6	9	1	5	7	6	7	2	0	6
5	8	0	4	5	1	1	3	2	9	0	8	8	6	9	4	5
6	9	0	8	9	0	6	0	2	3	1	8	9	9	3	7	9
7	4	0	5	3	8	2	0	9	2	1	2	1	1	5	7	0
8	7	2	3	0	3	5	5	6	6	2	2	5	7	7	7	9
9	4	5	2	5	9	6	9	5	9	6	1	8	6	5	3	0
10	7	5	8	1	2	6	6	9	9	0	3	5	0	5	6	1
11	8	1	6	7	6	4	0	1	2	8	8	1	4	7	8	5
12	7	2	0	6	2	2	1	0	2	2	1	8	1	5	7	0
13	7	1	1	7	5	6	1	7	3	8	3	1	2	9	8	5
14	7	0	7	7	2	6	7	9	3	0	4	3	8	4	5	0
15	7	2	0	8	7	4	6	1	1	3	3	9	4	2	6	8
16	8	3	2	8	6	9	2	4	1	7	8	4	1	6	6	8
17	8	2	4	3	7	2	4	5	8	2	4	7	3	5	7	4
18	3	4	4	6	8	7	9	5	7	0	7	8	1	0	3	6
19	4	9	0	8	2	8	5	9	1	9	5	5	1	4	3	7
20	7	7	1	3	7	2	6	0	5	4	8	3	7	6	1	9
21	3	5	1	5	9	9	7	6	9	1	8	9	7	3	4	6
22	1	1	8	0	2	9	0	0	8	2	6	3	1	2	7	3
23	8	4	6	6	2	3	8	1	9	9	6	3	0	8	5	0
24	6	0	1	0	9	5	5	7	4	5	7	8	1	1	6	2
25	6	9	3	9	1	9	6	3	5	5	2	7	7	3	2	2
26	8	7	3	6	6	8	8	8	8	6	6	6	8	3	5	2
27	8	2	6	0	6	8	0	1	1	9	1	3	1	1	8	8
28	4	0	0	9	0	8	8	3	1	6	4	9	3	0	0	3
29	5	1	1	6	2	7	7	5	9	7	1	2	2	0	0	0
30	6	7	6	7	4	0	2	4	8	4	3	5	0	7	6	1
31	5	0	6	4	1	0	1	9	8	5	1	3	8	1	4	0
32	4	2	4	9	0	0	0	0	1	3	2	0	3	6	0	2
33	5	8	3	1	9	1	0	4	2	3	9	9	2	0	5	6
34	4	1	6	7	5	3	4	7	0	8	2	1	4	9	8	3
35	9	6	8	1	1	3	3	1	1	5	9	4	4	3	4	5
36	0	9	2	8	2	4	9	9	3	5	1	5	3	6	1	0
37	2	7	5	6	8	7	9	5	2	3	6	6	1	2	9	2
38	0	0	7	5	9	8	9	5	9	3	1	2	9	8	6	9
39	1	7	8	3	0	0	1	1	4	6	5	5	8	2	8	4
40	2	7	0	7	7	5	0	3	8	1	9	3	0	1	0	0

/...

ANNEXURE - XVI

PROPOSED WORK SCHEDULE FOR IDD SURVEY IN NEPAL

S.No	District	Month & Year
1	RASUWA	May - June 1985 (Completed)
2	DOLPA	September - October, 1985
3	BAJHANG	September - October, 1985
4.	SANKHUASABHA	September - October, 1985
5.	PANCHATHAR	September - October, 1985
6.	MUSTANG	September - October, 1985
7.	MYGADI	September - October, 1985
8.	JUMLA	September - October, 1985
9.	KATHMANDU	December 1985
10.	LALITPUR	December 1985
11.	BHAKTAPUR	December 1985
12.	DOLAKHA	December 1985
13.	PARSA	December 1985
14.	NUVAKOT	December 1985
15.	SIRAHA	May - June 1986
16.	GORAKHA	May - June 1986
17.	RUPANDEHI	May - June 1986
18.	DANGDEOKHURI	May - June 1986
19.	BANKE	May - June 1986
20	KAILABI	May - June 1985
21	DADELDHURA	May - June 198

/...

Annexure-XVII

NEPAL

GOITRE & CRETINISM ERADICATION

PROJECT

Districts covered by Iodized Oil Injection Campaign 1980-1985

Second Edition

Annexure - XVIII

NEPAL

(ADMINISTRATIVE)

Scale 1 : 2,000,000

Kilometres 40 0 40 80 120 160

FAR WESTERN

MID WESTERN

WESTERN

CENTRAL

EASTERN

CHINA

INDIA

INDIA

BOUNDARY

International, Regional, Zonal, District

HEADQUARTERS

Capital, Development, Zonal, District

ROAD

Highway, Metalled, Unmetalled Under Construction

River, Lake, Peak, Pass ▲7205

BHERI GULMI

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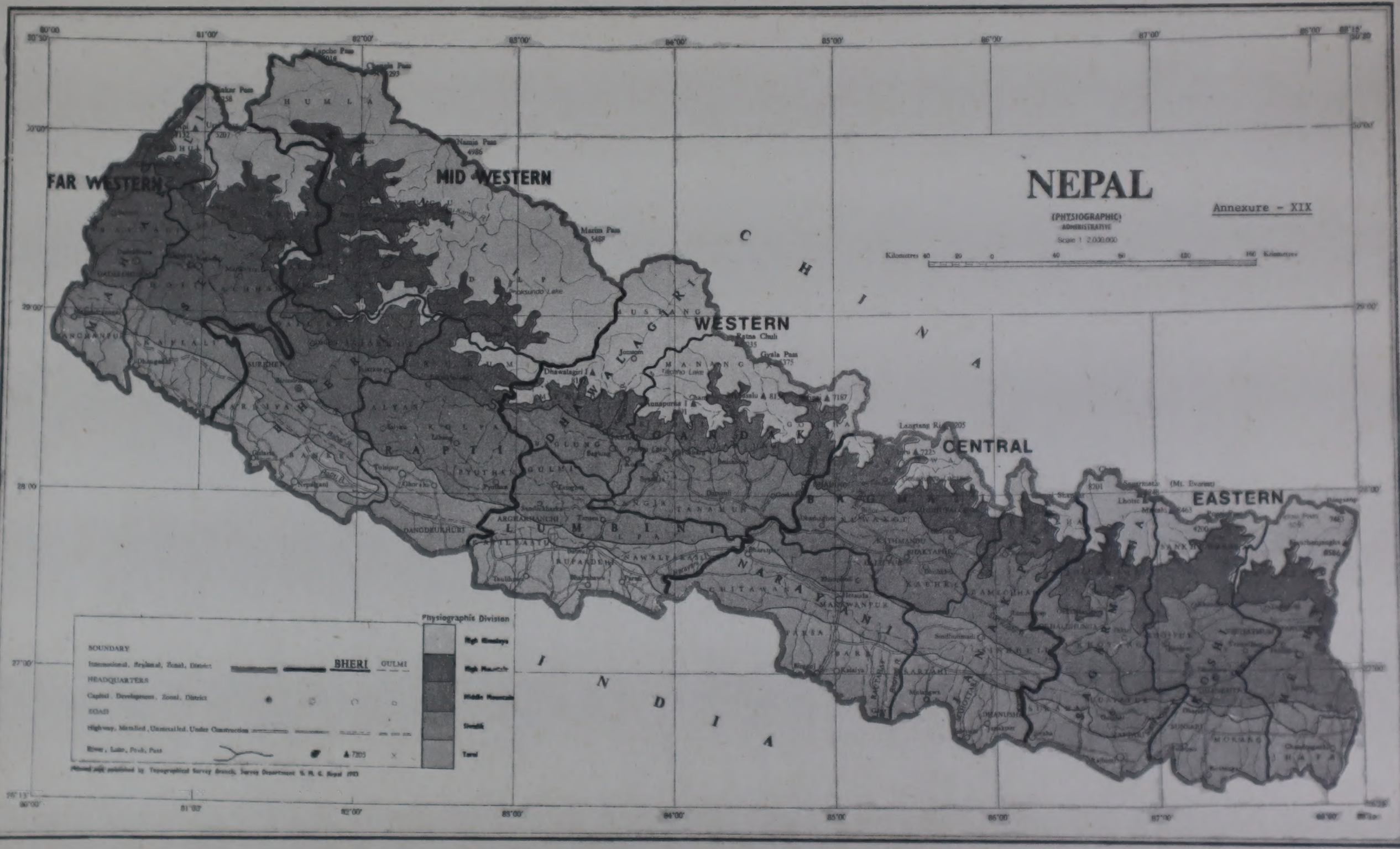
NEPAL
(PHYSIOGRAPHIC)
ADMINISTRATIVE
Annexure - XIX
Scale 1 2,000,000
FAR WESTERN
MID WESTERN
WESTERN
CENTRAL
EASTERN
BHERI
GULMI
Physiographic Division
SOUNDARY
HEADQUARTERS
ROAD
INDIA
CHINA

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